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PODOCORYNE SELENA, A NEW SPECIES OF HYDROID FROM THE GULF OF MEXICO, AND A COMPARISON WITH *HYDRACTINIA ECHINATA*

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Based on the adult medusa, Edwards (1972) has recently described a second species of *Podocoryne* from the New England coast of North America, *Podocoryne americana*, which had previously been called *P. carnea* Sars. *Podocoryne americana* attains an adult size of 3.5 mm in height with 24 to 32 marginal tentacles. *Podocoryne carnea*, which is also found in New England, is smaller and has fewer tentacles. The polyps of *P. carnea* and *P. americana* are very similar and the developmental stages of the medusae may also be confusingly similar, so that mature medusae may be necessary for positive identification of these two species.

In this paper a third species of *Podocoryne* from North America, found on the north Florida coast of the Gulf of Mexico, is described. *Podocoryne selena* n. sp. is probably the same hydrozoan that has been referred to as *P. carnea* in north Florida by McLean (1975), Menzel (1971), Wells (1969), Shier (1965), and Joyce (1961). In spite of repeated attempts, this author has never collected *P. carnea* in Florida. *Podocoryne selena* n. sp. may also be identical to *P. carnea* in Texas (Wright, 1973; Defenbaugh and Hopkins, 1973; and Deevey 1950, 1954) and Louisiana (Cary and Spaulding, 1909). The polyp of *P. selena* n. sp. is very similar to the polyp of *P. carnea*; medusae must be examined for positive identification in other coastal areas in order to establish the geographic ranges of the species of *Podocoryne* in North America.

The hydroids *Podocoryne* and *Hydractinia* live on hermit crab shells and other hard substrates on the Atlantic and Gulf coasts of the United States. In New England specimens of *Podocoryne carnea* and *Hydractinia echinata* are found in the same areas (Crowell, 1945), as are *P. selena* n. sp. and *H. echinata* in north Florida. For the non-specialist, it is sometimes difficult to distinguish *Podocoryne* from *Hydractinia*, both of which belong to the family Hydractiniidae. *Podocoryne selena* n. sp. and *H. echinata* are compared in this paper through the use of both phase contrast and scanning electron microscopy.

Materials and Methods

Hydroid colonies of *Podocoryne selena*, n. sp. were collected on the shells of live hermit crabs in the following locations in Frankin County, Florida: Alligator Point; Alligator Harbor; Baymouth Bar near Alligator Point and at the opposite end of the bar near St. Teresa; Wilson's Beach at St. Teresa; Turkey Point; and in St. Joseph Bay in Gulf County at several points between Presnell's Fish Camp and

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Black's Island. Animals were collected on sandy bottoms either by wading or snorkeling in 0 to 3 meters of water.

The hermit crabs and hydroid colonies were kept in the laboratory in 20-gallon glass aquaria containing natural sea water and were fed pieces of fish, shrimp, or octopus, and *Artemia* nauplii. The water was maintained at room temperature, approximately 20° C, and was filtered with both a sub-gravel filter and a Dyna-Flow outside filter.

Podocoryne selena n. sp. medusae were obtained by placing a shell covered with a colony of *Podocoryne* polyps with medusa buds in a bowl of sea water and exposing them to either bright daylight or artificial light. Medusae began to be liberated after about fifteen minutes and continued to be released for several hours. The newly released medusae were transferred to a fingerbowl of clean sea water with a pipette and were fed *Artemia* nauplii which they were able to ingest whole. The water was aerated gently. The medusae were transferred by pipette to a clean bowl of sea water every one or two days. Enough *Artemia* nauplii were added to sustain the medusae until the next change of water.

Nematocysts were identified using the key of Mariscal (1974a). Measurements of undischarged nematocysts were made using a Reichert phase-contrast microscope. Size ranges were determined by measuring at least ten of each type of nematocyst.

Specimens were prepared for the scanning electron microscope (SEM) by the procedure described by Mariscal (1974b) with the following modifications: prior to immersion in 16% glycerol for 24 hours, specimens were fixed in Parducz (1967) solution of six parts 2% aqueous OsO_4 and one part $HgCl_2$ saturated sea water for 45 minutes. Photographs were taken on Polaroid 105 Positive Negative Film by William Miller on a Cambridge Stereoscan S4-10 scanning electron microscope.

Taxonomy

Podocoryne selena new species (Figs. 1–4).

Diagnosis

Female medusae released with 8 marginal tentacles, male medusae released with 5 to 8 marginal tentacles; gonads with nearly mature sexual products at time of release. Tentacle number increases to up to 14 in two weeks in the laboratory. Maximum size reared was 1.8 mm in bell height and diameter. Polyps nearly identical to polyps of *P. carnea*. *Selene* is the ancient Greek name for the moon.

Description

Medusa (Figs. 1, 2). Newly released female medusae have 8 marginal tentacles and measure 0.8 mm in bell height and diameter. The bell is nearly spherical and the jelly is thin. The manubrium hangs down about two-thirds the length of the subumbrellar cavity. The mouth has four lips, each consisting of a battery of about 60 individual pendant microbasic euryteles (see Fig. 2). The surfaces of the mouth and manubrium are provided with scattered long, slow-beating cilia, as are the tentacles and inside surfaces of the radial canals. At release, the 4 perradial tentacles have well developed basal bulbs and the 4 interradial tentacles, which are somewhat shorter, have rudiments of bulbs. The tentacles and bulbs are

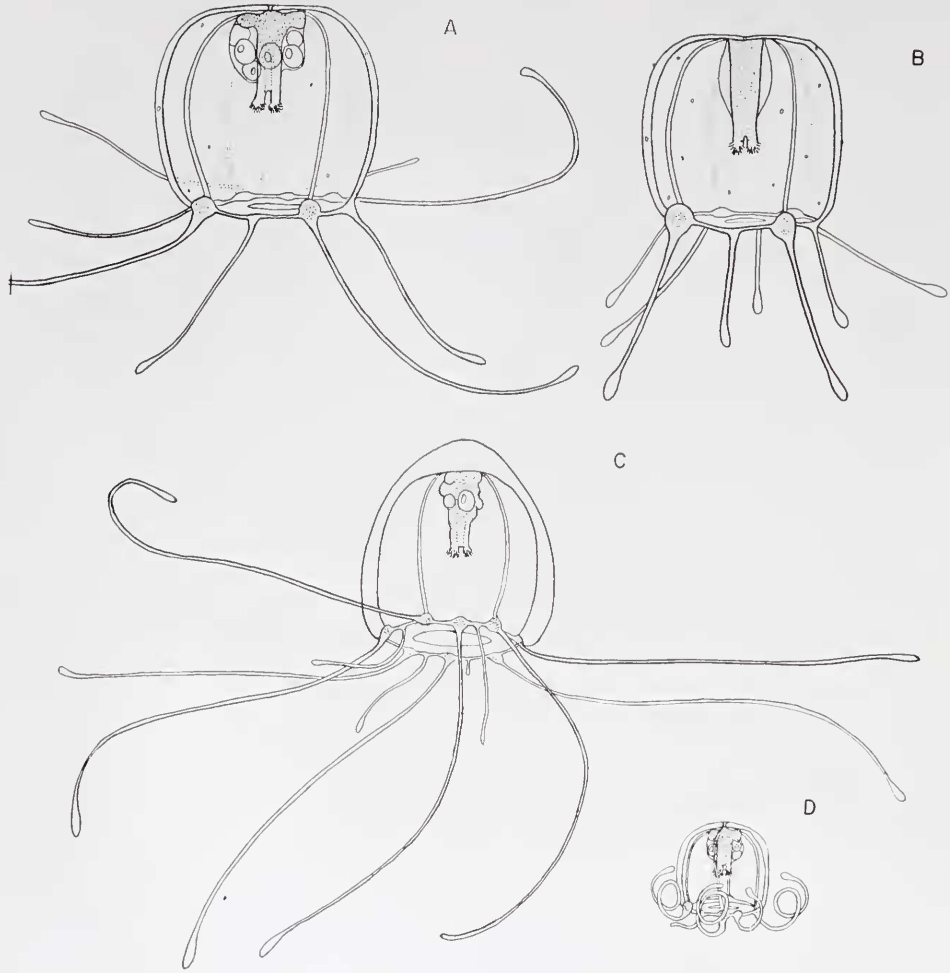

FIGURE 1. *Podocoryne selena* medusae from hydroid colony on hermit crab shell in north Florida Gulf of Mexico, all drawn from life. A. Newly released female, 0.8 mm in bell height and diameter, with nearly mature eggs in gonad surrounding manubrium. B. Newly released male, 0.6 mm in bell height and diameter, with immature testis surrounding manubrium. C. Female 13 days old, 1.6 mm in bell height and diameter. D. Newly released female, 0.8 mm in bell height and diameter, drawn to scale with mature female of Figure 1C; shown in typical posture with partly contracted tentacles.

sprinkled heavily with desmonemes and microbasic euryteles, not arranged into batteries. There are also a few nematocysts on the margin of the exumbrella between tentacles in the region of the ring canal. The exumbrella is very sparsely provided with desmonemes. The complete cnidom of *P. selena* is given in Table I. The four radial canals and ring canal are narrow. A short umbilical canal is evident on newly released specimens. The velum is broad. Many eggs with germinal vesicles can be seen on female medusae in the gonads surrounding the manubrium. Male medusae measuring 0.6 mm in bell height and diameter are released with 5 to 8 tentacles. The testis appears as a clear swelling around the manubrium which becomes milky white when the sperm mature. Eggs and sperm mature within 2 to 3 days, at which time the release of eggs begins. Eggs were released for 12 days in the laboratory. Sexually mature female medusae measured 1.2 mm in height and diameter when 3 days old. Sexually mature males measured 0.9 mm in height and diameter when 3 days old. Maximum size attained with a 2-week old female medusa measuring 1.8 mm in height and diameter. An incomplete second cycle of tentacles appeared in most specimens during the second week of life under laboratory conditions. Mature medusae were seen with 8 to 14 tentacles in two weeks and were usually 1.0 to 1.5 mm high at that time.

Polyps (*Fig. 3, 4*). The polyps of *Podocoryne selena* are similar to those of *P. carnea* as discussed by Edwards (1972) with differences as noted below. Spines in colonies of *P. selena* are usually up to 1.2 mm high, whereas those of *P. carnea* are reported by Edwards to be 0.2–0.3 mm high. The hydrorhizal base of the colony of *P. carnea* often grows out beyond the aperture of the shell-substrate which effectively enlarges the shell (Edwards, 1972). This type of growth has not been observed in *P. selena* in Florida.

Spiral zooids are usually present in *Podocoryne selena* colonies at the apertures of hermit crab shells and are most often located in a single row only on the shell edge above the crab. They are sometimes found encircling the entire shell aperture and may occur in a band several polyps deep. Spiral zooids were never seen in colonies of *P. selena* that covered shells of the live gastropod *Cantharus cancellarius.*

TABLE I

Nematocysts of Podocoryne selena *and* Hydractinia echinata *from the north Florida Gulf of Mexico. All capsules were measured undischarged; measurements are expressed in μm. An asterisk indicates that a nematocyst was present, but not measured.*

	Podocoryne selena		*Hydractinia echinata*	
	Desmonemes	Microbasic euryteles	Desmonemes	Microbasic euryteles
Hydroid				
Spiralzooid	None	12.0–14.5 × 4.0–5.0	None	12.0–14.0 × 4.0–5.0
Gonozooid	*	*	None	*
Gonophore	None	None	None	8.0–9.0 × 2.0 13.0 × 5.0
Feeding zooid	5.0–6.0 × 3.0	7.0–10.0 × 2.5–3.0 12.0–15.0 × 5.0–7.0	6.0–6.5 × 3.0	9.0–10.0 × 3.0–4.0 12.0–13.0 × 5.0–6.0
Medusa				
Exumbrella	5.0–6.0 × 3.0	None	Hydroid has fixed gonophores, no medusae	
Manubrium	None	9.0–11.5 × 3.0		
Tentacles	5.0–6.0 × 3.0	7.0–8.0 × 3.0		

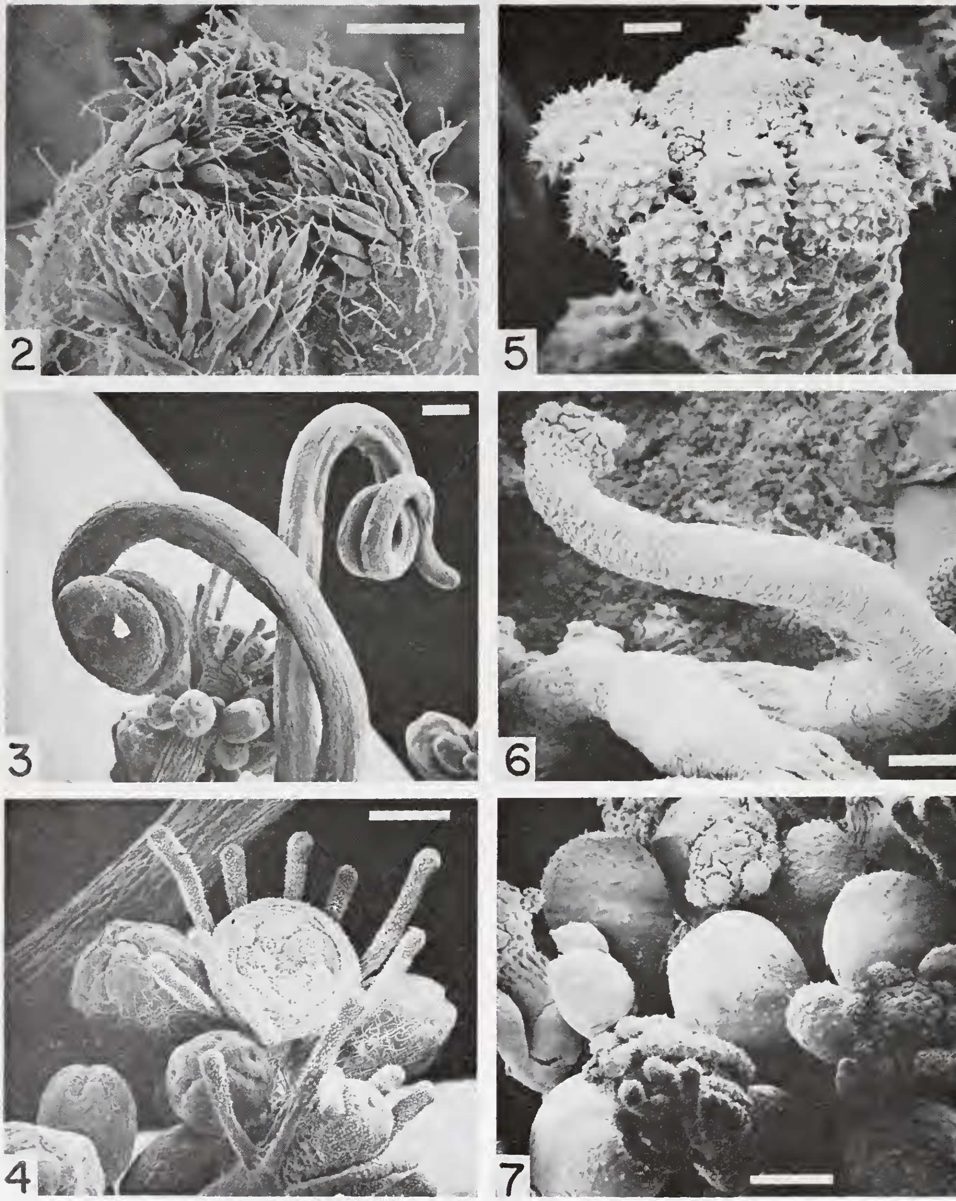

FIGURE 2. Mouth of *Podocoryne selena* with four lips, each consisting of a battery of about 60 individual pendant microbasic euryteles. Notes the long, flexible, cilia located on the lips and the surface of the manubrium. Scale bar equals 20 μm.

FIGURE 3. Two spiral zooids of *Podocoryne selena*. Reproductive zooid with medusa buds in background. Scale bar equals 100 μm.

FIGURE 4. Reproductive zooids of *Podocoryne selena* with medusa buds. Note open mouth on upper polyp. Scale bar equals 100 μm.

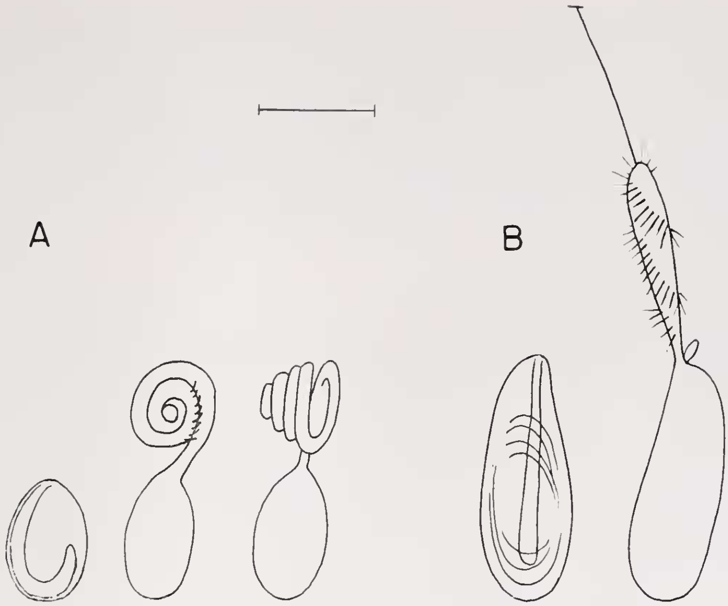

FIGURE 8. Nematocysts of *Podocoryne selena* and *Hydractinia echinata* from north Florida, drawn approximately to scale, as seen with phase contrast microscopy. The nematocysts of the two species are not morphologically differentiable. A. Desmonemes. B. Microbasic euryteles. Scale bar equals 5 μm.

Spines are usually present throughout the colony of *P. selena* on both live and hermit crab shells. Feeding zooids in colonies on hermit crab shells are generally located on the underside of the shell and reproductive zooids are located on the top and sides of the shell. Tentaculozooids were often seen at the edges of colonies in the laboratory that were either growing and expanding or regressing, the latter when insufficiently fed. On shells of the live gastropod *Cantharus*, feeding and reproductive polyps and spines were interspersed over the entire surface.

Type locality

Turkey Point, Franklin County, Florida (29° 56′ north latitude, 84° 30′ west longitude), in one meter of water.

Type material

The type specimen is an 11-day old female medusa with eggs. It has 13 tentacles and the preserved bell dimensions are 1.0 mm in both height and diameter.

FIGURE 5. Tip of reproductive zooid of *Hydractinia echinata* (similar to tip of spiral zooid of *H. echinata*). Scale bar equals 20 μm.

FIGURE 6. Spiral zooid of *Hydractinia echinata.* Feeding zooid can be seen in foreground. Scale bar equals 100 μm.

FIGURE 7. Reproductive zooids of *Hydractinia echinata* with fixed gonophores. Feeding zooid with long tentacles can be seen in center foreground. Scale bar equals 100 μm.

This holotype, preserved February 22, 1975, has been deposited at the National Museum of Natural History (Smithsonian Institution). Six lots of paratypes have also been deposited at the NMNH: (1) twenty-five newly released female medusae, (2) ten newly released male medusae, (3) ten 3-day old female medusae, (4) ten 3-day old male medusae, (5) fifteen 11-day old female medusae, (6) one polyp colony with medusa buds on a *Polinices duplicatus* shell containing the hermit crab *Pagurus pollicaris*. Additional paratype specimens have been deposited in the British Museum (Natural History), London.

Distribution and seasonal occurrence

Podocoryne selena polyps have been collected in Franklin County and Gulf County, Florida. It is probable that *P. selena* is found over a larger range, perhaps along most of the U. S. Gulf of Mexico coast. Whether *P. selena* is also found on the Atlantic coast of the U. S. has not yet been determined. Substrates for the polyps include the live horseshoe crab *Limulus polyphemus* (Shier, 1965), live *Cantharus cancellarius* shells, some dactyls and chelae of one specimen of the hermit crab *Pagurus pollicaris,* and the following hermit crab shells: *Busycon contrarium, Fasciolaria lilium hunteria, Murex pomum,* and *Pleuroploca gigantea,* containing the crab *Pagurus pollicaris*; and *Murex florifer dilectus, Polinices duplicatus,* and *Cantharus cancellarius* shells, containing the crabs *Pagurus pollicaris* or *Pagurus longicarpus.*

Podocoryne selena polyps have been collected every month except August and September in shallow subtidal (0–3 meters) waters in north Florida. Since robust, fully reproductive colonies have been collected at all other times, it is suspected that *Podocoryne selena* produces medusae year-round. Data that will be presented in a forthcoming paper discussing the interactions between these hydroids and hermit crabs in north Florida, indicates that conditions for planular settlement may become more favorable as spring progresses, since the number of young colonies increases considerably at that time.

Discussion

Edwards (1972) has reviewed the species of *Podocoryne* found in Britain which includes *P. carnea*. He notes that *P. carnea* has two forms in Europe, separated by a geographic cline of variation. The northern form seems to be similar to *P. carnea* in New England, although good descriptions of the developmental stages of medusae in New England are not available. *Podocoryne selena* is compared with northern and southern European forms of *P. carnea* as discussed by Edwards in Table II. Edwards speculates that the cline of variation observed in Europe for *P. carnea* may result from the longer life, larger size, greater numbers of tentacles, and slower sexual development in cooler waters. *Podocoryne selena* in the relatively warm waters of the Gulf of Mexico matures more rapidly, but also has more tentacles than *P. carnea*. *Podocoryne selena* also has far fewer exumbrellar nematocysts and fewer and larger eggs than *P. carnea,* and was never seen with a peduncle in any stage of development. *Podocoryne selena* medusae lived a maximum of 22 days in the laboratory, but their condition seemed to be deteriorating after the first two weeks. No data on *P. selena* in the plankton have been recorded.

TABLE II

Comparison of the medusae of northern and southern European Podocoryne carnea *and* Podocoryne selena. *Data for* P. carnea *are from Edwards (1972), Haeckel (1880), and Neppi (1917). Good descriptions of the developmental stages of* P. carnea *medusae in New England are not available.*

	P. carnea form *carnea* Northwest Europe and Britain	*P. carnea* form *exigua* Mediterranean (Naples)	*Podocoryne selena* north Florida
Newly released:			
Size	0.7–0.8 mm high	0.54 mm high	0.6–0.8 mm high
Number of tentacles	5–8 (mostly 6–7)	4 (rarely 5–7)	8 (rarely 5–7)
Condition of gonads	Usually present, rudimentary	Advanced	Advanced, almost ripe
Exumbrellar nematocysts	Many	?	Few
Adult medusa:			
Size	Usually 1.6–2.0 mm high maximum 2.4 mm high	0.8–1.2 mm high	Usually 1.0–1.5 mm high maximum 1.8 mm high
Number of tentacles	8 (some 7, 9)	4 (rarely 5)	8–14
Maturation of gonads	In 3 weeks	"Rapidly"	In 2 days

The medusae of *P. selena* are relatively inactive. Much of the time in the laboratory, they were seen on the bottoms of the culture dishes with tentacles partially extended, as in Figure 1A. Newly released medusae were more vigorous than older animals, swimming more of the time and often holding their tentacles contracted and curling up around the bell as in Figure 1D. The addition of *Artemia* nauplii to culture water containing starved medusae, caused the oral lips of the medusae to begin moving, each separately, in a groping fashion. When feeding, the medusae caught *Artemia* nauplii on their tentacles which were then contracted. The food particle was then stuffed through the small velar opening and was eventually contacted by the "groping" oral lips. The lips, consisting of batteries of large pendant microbasic euryteles (Fig. 2), maneuvered the food which was apparently being moved upwards into the stomach by muscular action, repeatedly grasping a little further down the length of the nauplius which was moved quite rapidly into the stomach. The medusae were capable of ingesting several nauplii in rapid succession. After catching 5 to 10 nauplii, the tentacles seemed to lose their ability to retain any further nauplii that they contacted, which suggests that few nematocysts were firing, similar perhaps to the results of Sandberg, Kanciruk, and Mariscal (1971) and Smith, Oshida, and Bode (1974). Nauplii that were contacted at this time showed little evidence of the immediate paralysis that occurred with the first-captured nauplii.

Specimens of both *Podocoryne selena* and *Hydractinia echinata* (Figs. 5–7) are found on hermit crab shells on the north Florida Gulf coast. In no instances have both species of hydroid been found on the same shell, although a few shells with *Hydractinia* appeared to have two colonies, separated by a distinct boundary, living

TABLE III

Differences between the hydroids Podocoryne selena *and* Hydractinia echinata.

Character	*Podocoryne selena*	*Hydractinia echinata*
Gonophores	Releases free medusae	Fixed, releasing eggs or sperm directly into water
Spines	Smooth	Usually, but not always, jagged
Spiralzooids	Have no tentacles, nematocysts especially dense near the tip	With stubby tentacles in a distal whorl, which serve as nematocyst batteries
Gonozooids	With tentacles similar to, but in lesser number than, nutritive zooids	With reduced stubby tentacles similar to those of spiralzooids
	Gonophores borne in whorled cluster below tentacles	Gonophores borne in whorled cluster below tentacles

on the same shell. In general, either species of hydroid might be found on any hermit crab shell in north Florida occupied by crabs in the genus *Pagurus* (the crab *Clibanarius vittatus* does not occupy hydroid-covered shells). There seem to be no clear cut preferences by either species of hydroid for any species of shells. In contrast to this situation in Florida, Crowell (1945) reports that in the vicinity of Woods Hole, in New England, where either *P. carnea* or *H. echinata* might be found on several species of hermit crab shells with apparently little demonstration of specificity, only *P. carnea* is found on *Nassa trivittata* shells, and *Littorina littorea* shells almost always support colonies of *H. echinata*.

The species *Podocoryne* and *Hydractinia* are closely related, both belonging to the family Hydractiniidae, but are easily distinguished when the colonies bear gonophores. *Podocoryne* releases free medusae whereas *Hydractinia* bears fixed gonophores which release gametes directly into the sea. Table III lists some easily recognizable difference between *P. selena* and *H. echinata*. The cnidoms are quite similar and are given in Table I and illustrated in Figure 8. Both species have desmonemes and microbasic euryteles.

It is interesting to note that the range of *H. echinata* closely corresponds to that of *P. carnea*. Both are found in north European waters, the Mediterranean Sea, and the north Atlantic coast of North America. *Hydractinia echinata* is also described from the Sea of Japan and more northern Pacific and Arctic waters (Naumov, 1969). Since *P. selena* seems to replace *P. carnea* in warmer water, it is possible that the *Hydractinia echinata* in the Gulf of Mexico is not the same species as the temperate and boreal form of *H. echinata*, but there is no readily observable characteristic like the medusae of *Podocoryne* that clearly suggests this hypothesis.

Spiral zooids are found in some species in the family Hydractiniidae, including *P. carnea, P. selena,* and *H. echinata*, on hermit crab shells. The function of spiral zooids in the polyp colonies is unclear. They are commonly believed to serve a defensive function for the hydroid colony, as is suggested by their morphology and the distribution of nematocysts on their surfaces (see Figs. 3 and 6). Spiral zooids respond to movement of the hermit crab shell, but not specifically to tactile stimulation to the spiral zooid. By jostling a hermit crab shell briefly, this author was able to make the spiral zooids lash out simultaneously and repeatedly, but similar behavior was not observed during extensive hermit crab shell changing experiments involving three species of hermit crabs (*Pagurus pollicaris, Pagurus longicarpus,* and *Clibanarius vittatus*) and hydroid-covered shells. Schijfsma (1935) also attempted to discover the purpose of spiral zooids in *H. echinata* in Europe. After extensive experimentation, she could find no explanation of their purpose and no evidence that they were a special adaptation of the hydroid that served to benefit the host hermit crab, as has been suggested. Wright (1973) also does not report any special defensive behavior by *H. echinata* or *P.* "*carnea*" spiral zooids, nor does M. Braverman (Taos, New Mexico, personal communication). Braverman (1974) found that spiral zooids form in response to the movements of the hermit crabs in and out of the shells. Burnett, Sindelar, and Diehl (1967) hypothesized that some diffusable material produced by the hermit crab was a contributing factor to the growth of spiral zooids on the shell. The purpose of spiral zooids thus remains an intriguing problem.

The arrangement of polyps in *Podocoryne selena* and *Hydractinia echinata* colonies in Florida is such that the nutritive polyps are situated on the underside of the shell and are dragged over the sand as the hermit crab moves. In a similar situation in Denmark, Christensen (1967) found, by analyzing the stomach contents of *Hydractinia echinata* polyps growing on the shells of the hermit crab *Pagurus bernhardus,* that the hydroid was deriving 90% of its food from the benthos, eating primarily nematodes, ophiuroid arm joints, and harpacticoid copepods. No food analysis has been done on *P. selena* or *H. echinata* in Florida, but they presumably feed in the same manner.

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Summary

1. A new species of hydroid, *Podocoryne selena,* is described from the north Florida Gulf of Mexico. This hydroid has mistakenly been called *P. carnea* in the past; polyps are very similar in the two species. It cannot be determined whether *P. carnea* actually occurs in subtropical waters until mature medusae are examined in other regions.

2. Observations on the behavior of the polyps and medusae of *P. selena* are given.

3. The species *Podocoryne selena* and *Hydractinia echinata* are both found living on hermit crab shells in the Gulf of Mexico. The two species are compared and morphological differences are illustrated with scanning electron micrographs.

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